Audiovisual Analytics of social linked data

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Abstract: Audiovisual analytics of social data is useful for State and private management, scientific and individual endeavors. If there is data, information or knowledge in a computer, the observer or user should have it, the use of visual cues is an obvious, and sometimes considered optimized, strategy because of the efficiency and complexity of our visual cognition. Our sonic cognition is sometimes considered of greater complexity, due to patterns of music and spoken language. How to correctly formalize the mapping of data, information and knowledge to physical stimuli and then to the perceived stimuli respecting the Weber-Fechner and Steven's laws at least for visual and auditory cues?

1. Introduction

Linked data is useful for data integration from different sources, for semantic representation and manipulation of data, such as by automated inferences, and sound conceptual considerations of both domain and context knowledge. The mapping of data to audiovisual cues involves a number of routines, conceptual frameworks, and data. The scaling and integration factors are decisive in setting of Big Data such as in social data mining. The study of data that expresses human social systems poses ethical and conceptual challenges [1, 2]. An overview of the Linked Open Social Data translated to RDF and related ontologies and vocabularies can be found in [3–5]. Some limitations of current linked data standards are described and potential solutions given in [6].

2. Current Framework

We obtained compelling algebraic, empiric and conceptual analyses of social structures [4, 7], often supported by software, which is a very efficient way to represent what is being performed (although also very incomplete). In this section, we focus on current efforts around Audiovisual Analytics.

2.1. AAVO

AAVO is a first tentative ontology for Audiovisual Analytics. Figure 1 depicts the AAVO Core, and both Core and Extended AAVO are well described in [8]. The following concepts are envisioned for the core but not yet implemented: Hypothesis, Analysis, Task/Purpose/Application. Some relations seem less fundamental then others, which might be expressed using the techniques described in [6]. AAVO is very incipient, and will most probably receive other layers of conceptualizations beyond Core and Extended, such as for data type, colors, charts, etc.

Its purposes are: automated inferences and recommendations on contexts involving data visualization (e.g. for suitable visualizations given a dataset or vice-versa); enable relevant theoretical discussions by having an established and formal conceptualization; provide a representation of data that is friendly for both humans and machines (in browsing, discovery, inference); underpin data integration; provide the conceptual and data architecture for the audiovisual analytics software described in the next section.

2.2. An audiovisual analytics platform for social systems

A software system, a web platform for audiovisual analytics of big data, has been envisioned with the following characteristics:

- Interface has capabilities of making automated and periodic changes of the presentation of the content (data and analyses). This entails a fractal and musical consideration of the audiovisualzations. User might pause and set changing patterns.

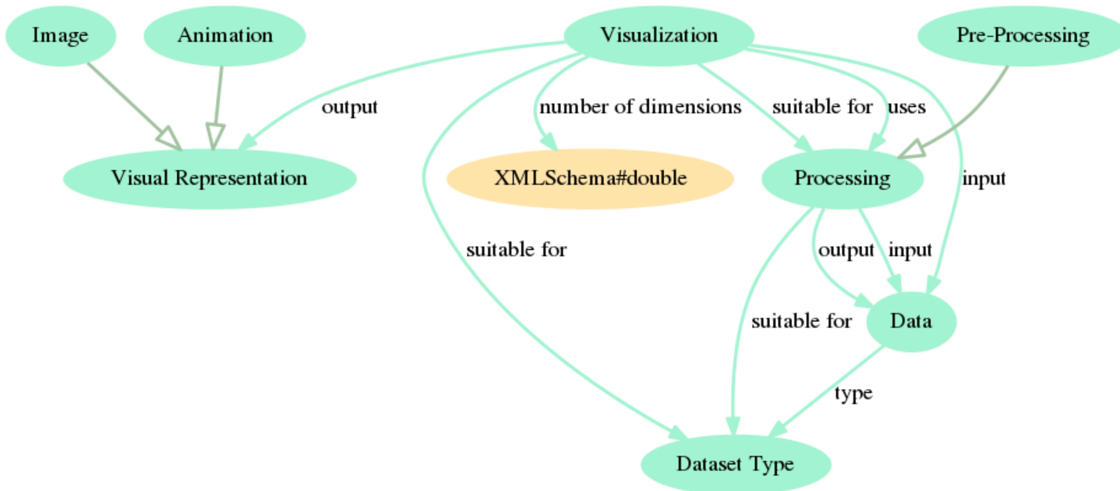

Fig. 1. A graphical representation of current AAVO Core. More information in Section 2.1.

- The simultaneous use of both the vision and auditory channels. User might mute or focus on the sonic cues.
- The system has the purpose of providing an aesthetic experience to the user. This includes facilities to render audiovisual media for aesthetic appreciation or attractive representation of analyses [9].
- Keeps records of state through users and sessions. Each session has a set of states, each state a set of interface parametrization and data references. Annotations might be linked to users, sessions, states, data, analysis methods, widgets, etc; and categorized by keywords or simple values.
- Persistence (probably through the web browser's sandbox) to allow a user to reload already downloaded software and data, and to allow a user to work offline.
- Sharing of sessions, states, data, and annotations among users, preferably in real time (as achieved through Meteor.js). Sharing of media to non-users and for presenting results.
- A written interface to control the system which should be suitable for scripting, one line commands, keyboard shortcuts. It will probably be JavaScript with Vim-like one-liners and scripting. (The written interface expresses a very broad space of possible commands.)
- Linked data to achieve a formal and browse-friendly representation of data for both humans and machines; for a unified consideration of both data and knowledge architecture; facilitates the linkage of metadata from users; facilitates resources recommendations.
- Emphasis on the analysis of networks and text (and their simultaneous analysis), reason why it is fit for social networks, but also for general complex networks and textual data.
- Designed to be enhanced with use by means of tests with users, and of analyses of sessions and states (maybe have facilities to record mouse movement, clicks and keyboard strokes).

The temporal dynamic of the interface is useful to do a rapid scan of the data by parts. Observing data by parts is a core procedure in mining big data. Persistence is also valued for the purpose of analyzing big data. Complex networks and text yield a broad user base and set of knowledge fields which might be studied withing the system. The focus on social systems entails analysis results of interest to scientific research, State and private sectors. Art in current and envisioned developments is useful for formal documents and favors the engagement of layman.

2.3. *Perceptual framework*

Frequency and intensity are related to pitch and volume through the Weber-Fechner laws. One might also think about durations on the same sense. Visual estimuli, on the other hand, seem to be more often modeled as the Steven's law. Is it possible to relate frequency and intensity to pitch and loudness through Steven's laws? Is the perception of visual cues also fit by the Weber-Fechner? The Steven's law is a power law while Weber-Fechner is an exponential law. This entails:

$$\Delta p = log_X(e_1/e_0) \tag{1}$$

for Weber-Fechner and

$$p = k.e_1^{\alpha} \tag{2}$$

for Steven's, where p is the (subjective) magnitude of the perceived stimuli, X and α depend on the stimuli, and e_0 and k depend on the the units used.

In equally spaced samples of the stimuli (e.g. in PCM audio), the sample values might express amplitude or frequency. If the sample values represent durations, the separation between samples looses its meaning, but enables a Fourier analysis in a 'virtual' or 'imaginary' space.

The possible equations relating physical and perceived stimuli should be integrated to AAVO.

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Some perception measurements are very consistently represented by exponentil laws, such as betweeen pich and frequency. Loudness is also more or less consistently related by exponentials to the power, intensity or amplitude for a fixed frequency or spectrum. Visual cues, on the other hand, present consistent power laws.

mention the human processor model.

Related to sound, most traditional notation and musical qualities respect the Weber-Fechner law, with note grids (e.g. semitones, octaves), respecting the logarithm of frequency: interval= $log_2(f_1/f_0)$, loudness= $log_10(p_1/p_0)$. Duration seems also to be conceptualized as such because musical notation uses the division in two (simple, imperfectus), amd three (perfectus) yielding a grid having $d_i = d_{i+1}/2$ and $d_i = d_{i+1}/3$. $durations = 2^{x-i}$ and $= 3^{x-i}$. Which implies $log_2(dur) = x - i$. A Weber-Fechner compliant relation between the number of the durations and depth of the division x-i = (4, 8, 16) for simple, (3, 9, 12) for compound, (5,7,13) complex. 6 is compound in traditional music theory, but is the only one that relates periods of 2 and 3, subdivision of 2 and 3.

2.4. *Other: Erdös Sectioning, KS-derived statistics, Wordnet, text mining, stability and differentiation, partnerships*

Other works, such as classification of participants (vertices) as hubs, intermediary and periphery, statistical tests e.g. to observe linguistic differences among the network participants, the use of Wordnet and token-oriented methods for text mining, and current partnership with researchers in physics, computer science, mathematics, philosopy and social sciences, clinical and social psychology, give some of the support for our endeavors.

2.5. *What to do?*

We will surely integrate the Hypothesis, Goals, Interaction concepts into the AAVO Core. We should develop the system in Section 2.2 to some extent, maybe for concept proofs or simple prototyping.

With the research groups @Nuvem, relate the missing concepts in AAVO, enhance the software design of the system, Know about the right tools for visualizing ontologies and social data. For knowing about pertinent analysis methods and known conceptualizations. Virtual reality, visualization and societal groups might want to formalize their own conceptualizations, and concepts related to AAVO might have similar developments or which are confluent (e.g. symbiotic) with Section 2: software theoretical framework, research and institutional experiments and equipment, linked data, and other initiatives or knowledge.

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